



Faculty of Mathematics and Natural Science  
Yogyakarta State University



ISBN 978-602-74529-0-9



**Proceedings**

“ The Global challenges on the development  
and the education of mathematics and science “

**3<sup>rd</sup> ICRIEMS**

**Proceedings**

# **3<sup>rd</sup> ICRIEMS**

**3<sup>rd</sup> International Conference on Research  
Implementation, and Education of  
Mathematics and Science 2016**

**“ The Global challenges on the development  
and the education of mathematics and science “**

**16 - 17 May 2016  
Yogyakarta State University**



ISBN 978-602-74529-0-9

Conference Proceedings

---

3<sup>rd</sup> INTERNATIONAL CONFERENCE ON RESEARCH,  
IMPLEMENTATION AND EDUCATION OF  
MATHEMATICS AND SCIENCE (3<sup>rd</sup> ICRIEMS)  
Yogyakarta, 16 – 17 May 2016

---

ISBN 978-602-74529-0-9

The Global Challenges on The Development and  
The Education of Mathematics and Science

Faculty of Mathematics and Science  
Yogyakarta State University

# 3<sup>rd</sup> ICRIEMS : The Global Challenges on The Development and The Education of Mathematics and Science

- Mathematics & Mathematics Education
- Physics & Physics Education
- Chemistry & Chemistry Education
- Biology & Biology Education
- Science Education

Published by:  
Faculty of Mathematics and Science  
Yogyakarta State University  
Karangmalang, Yogyakarta 55281  
Telp. (0274)550227, Fax. (0274)548203

© June 2016

## **Board of Reviewer**

Prof. Allen Price, Ph.D (Emmanuel College Boston, USA)  
Ana R. Otero, Ph.D (Emmanuel College Boston, USA)  
Dr. Michiel Doorman (Utrecht University, Netherlands)  
Prof. Dr. Marsigit (Yogyakarta State University)  
Prof. Dr. Mundilarto (Yogyakarta State University)  
Prof. Dr. Sriatun (Yogyakarta State University)  
Prof. Dr. A.K. Prodjosantoso (Yogyakarta State University)  
Prof. Dr. IGP. Suryadarma (Yogyakarta State University)  
Prof. Dr. Bambang Subali (Yogyakarta State University)  
Dr. Ariswan (Yogyakarta State University)  
Dr. Agus Maman Abadi (Yogyakarta State University)  
Dr. Dhoriva Urwatul U. (Yogyakarta State University)  
Dr. Sugiman (Yogyakarta State University)  
Dr. Karyati (Yogyakarta State University)  
Dr. Slamet Suyanto (Yogyakarta State University)  
Dr. Supahar (Yogyakarta State University)  
Dr. Siti Sulastri (Yogyakarta State University)  
Dr. Insih Wilujeng (Yogyakarta State University)  
Wahyu Setyaningrum, Ph.D. (Yogyakarta State University)  
Aryadi Wijaya, Ph.D. (Yogyakarta State University)

## Preface

Bless upon God Almighty such that this proceeding on 3<sup>rd</sup> International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) may be compiled according to the schedule provided by the organizing committee. All of the articles in this proceeding are obtained by selection process by the reviewer team and have already been presented in the Conference on 16 – 17 May 2016 in the Faculty of Mathematics and Natural Sciences, Yogyakarta State University. This proceeding comprises 9 fields, that is mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of this 3<sup>rd</sup> ICRIEMS is '*The Global Challenges on The Development and The Education of Mathematics and Science*'. The main articles in this conference are given by six keynote speakers, which are Prof. Allen Price, Ph.D (Emmanuel College Boston USA), Ana R. Otero, Ph.D (Emmanuel College Boston USA), Dr. Michiel Doorman (Utrecht University, Netherlands), Prof. Dr. Marsigit, M.A (Yogyakarta State University), Asst. Prof. Dr. Warakorn Limbut (Prince of Songkla University, Thailand), and Prof. Dr. Rosly Jaafar (Universiti Pendidikan Sutan Idris, Malaysia). Besides the keynote and invited speakers, there are also parallel articles that presented the latest research results in the field of mathematics and sciences, and the education. These parallel session speakers come from researchers from Indonesia and abroad.

Hopefully, this proceeding may contribute in disseminating research results and studies in the field of Mathematics and Sciences and the Education such that they are accessible by many people and useful for the Nation Building.

Yogyakarta, May 2016

The Editor Team

## Forewords From The Head Of Committee

Assalamu'alaikum warahmatullahi wabarakatuh

May peace and God's blessings be upon us all

First of all, allow me to thanks to God, Allah SWT, who has been giving us blessing and mercies so we can join this conference. Ladies and Gentlemen, it is my great honor to welcome you to Indonesia, a unique country which has more than 17,000 islands, more than 1,300 ethnic groups, and more than 700 local languages, and I am also very happy to welcome you to Yogyakarta, the city of education, culture, tourism, and a miniature of Indonesia. We wish you be happy and comfortable in attending the conference in this city.

The third International Conference on Research, Implementation, and Education of Mathematics and Science (ICRIEMS 3<sup>rd</sup>) 2016 is organized by the Faculty of Mathematics and Science, State University of Yogyakarta. In this year, theme of the conference is : The Global Challenges on The Development and The Education of Mathematics and Science. This conference are dedicated to the 52<sup>nd</sup> anniversary of Yogyakarta State University and to face challenges of Asean Economic Community in 2016.

This conference facilitates academics, researchers and educators to publish and disseminate their research in the fields of pure, application and education of Science and Mathematics. Furthermore, the purposes of the conference are to establish interaction, communication, and cooperation among academics, researchers and educators at an international level.

On behalf of the committee of this conference, I would like to express our highest appreciation and gratitude to the keynote speakers, including:

1. Allen Price, Ph.D. (Associate Professor of Emmanuel College, Boston USA)
2. Ana R. Otero, Ph.D. (Emmanuel College, Boston USA)
3. Dr. L.M. (Michiel) Doorman (Associate Professor of Utrecht University, Netherland)
4. Prof. Dr. Marsigit, MA. (FMIPA, Universitas Negeri Yogyakarta)
5. Asst. Prof. Dr. Warakorn Limbut (Faculty of Science, Prince of Songkla University, Thailand)
6. Prof. Dr. Rosly Jaafar (Faculty of Physics, Universiti Pendidikan Sultan Idris, Malaysia)

Furthermore, we inform you that the papers presented in this conference are about 200 papers from 302 applicants, who come from various countries and various provinces throughout Indonesia. Therefore, I would like to give my appreciation and many thanks to the presenters and participants who have been actively involved in this seminar.

Finally, I would like to thank the committee members who have been working very hard since half a year ago to ensure the success of the conference. However, if you find any shortcomings and inconveniences in this conference, please forgive us. We would very

happy to receive your suggestions for improvement in the next conference. Thank you very much.

Wassalamu'alaikum warohmatullahi wabarakatuh.

Yogyakarta, May 2016

Dr. Warsono, M.Si.

## **Forewords From The Dean Of Faculty Of Mathematics And Sciences, Yogyakarta State University**

Assalamu'alaikum warahmatullahi wabarakatuh. My greetings for all of you. May peace and God's blessings be upon us all.

On behalf of the Organizing Committee, first of all allow me to extend my warmest greeting and welcome to the International Conference on Research, Implementation, and Education of Mathematics and Sciences, the third to be held by the Faculty of Mathematics and Science, State University of Yogyakarta, one of the excellent and qualified education universities in Indonesia. This conference is also celebrate the 52th Anniversary of State University of Yogyakarta.

This conference proudly presents keynote speeches by six excellent academics, these are: Allen Price, Ph.D., Ana R. Otero, Ph.D., Dr. Michiel Doorman, Prof. Dr. Marsigit, MA., Asst. Prof. Dr. Warakorn Limbut, and Prof. Dr. Rosly Jaafar, and around 200 regular speakers.

The advancement of a nation will be achieved if education becomes a priority and firmly supported by the development of technology. Furthermore, the development of technology could be obtained if it is supported by the improvement of basic knowledge such as mathematics, physics, chemistry, and biology. The empowerment of this fundamental knowledge may be achieved by conducting research which is then implemented in developing the technology and the learning process in schools and universities.

This international conference is aimed to gather researchers, educators, policy makers, and practitioners to share their critical thinking and research outcomes. Moreover, through this conference it is expected that we keep updated with new knowledge upon recent innovative issues and findings on the development and the education of mathematics and science, which is in accord with the theme of the conference this year. All material of the conference which are compiled in the abstract book and proceedings can be useful for our reference in the near future.

This conference will be far from success and could not be accomplished without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members who have done an excellent job in organizing this conference. I would also like to thank each of the participants for attending our conference and bringing with you your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept our sincere apologies.

To conclude, let me wish you fruitful discussion and a very pleasant stay in Yogyakarta.

Wa'alaikumsalam warahmatullahi wabarakatuh

Yogyakarta, May 2016  
Dean Faculty of Mathematics and Science  
Yogyakarta State University

Dr. Hartono, M.Si.





## Table of Content

	<b>page</b>
<b>Front Cover</b>	i
<b>Board of Reviewers</b>	ii
<b>Preface</b>	iii
<b>Forewords From The Head of Committee</b>	iv
<b>Forewords From The Dean of Faculty</b>	v
<b>Table of Content</b>	ix
<b>Keynotes:</b>	
01 <b>Lesson Study Among The Move Of Educational Reformation in Indonesia</b> <i>Marsigit</i>	U-1
02 <b>The Scientific Approach To Higher Education: Examples From Physics Education Research</b> <i>Allen Price</i>	U-17
03 <b>Current Trends In Active Learning In The Sciences</b> <i>Ana R. Otero</i>	U-21
04 <b>What Can Mathematics Education Contribute To Preparing Students For Our Future Society?</b> <i>Michiel Doorman</i>	U-25
<b>Regular Papers:</b>	
<b>MATHEMATICS</b>	
01 <b>Spatial Extreme Value Modeling Using Max-Stable Processes Approach (Case Study: Rainfall intensity in Ngawi)</b> <i>Arief Rachman Hakim, Sutikno, Dedy Dwi Prastyo</i>	M – 1
02 <b>Bivariate Binary Probit Model Approach for Birth Attendance and Labor Participation in West Papua</b> <i>Ayu Tri Septadianti, Vita Ratnasari, Ismaini Zain</i>	M – 9
03 <b>Parameter Estimation and Hypothesis Testing on Bivariate Generalized Poisson Regression</b> <i>Dian Kusuma Wardani, Purhadi, Wahyu Wibowo</i>	M – 15
04 <b>Scour Analysis at Seawall in Salurang, Sangihe Islands Regency, North Sulawesi</b> <i>Eunike Irene Kumaseh, Suntoyo, Muh.Zikra</i>	M – 21

05	<b>Longitudinal Tobit Regression Modelling Stroke Patients With Trauma/Injury HeadTrauma</b> <i>Evy Annisa Kartika S, Ismaini Zain, Vita Ratnasari</i>	M – 27
06	<b>Multilevel Structural Equation Modeling For Evaluating The Effectiveness Of Remuneration In ITS Surabaya</b> <i>Farisca Susiani, Bambang W. Otok, Vita Ratnasari</i>	M – 31
07	<b>Cox Proportional Hazard Model with Multivariate Adaptive Regresion Spline</b> <i>Hendra Dukalang, B. W. Otok, Ismaini Zain, Herlina Yusuf</i>	M – 37
08	<b>Parameter Estimation and Statistical Test in Modeling Geographically Weighted Poisson Inverse Gaussian Regression</b> <i>Ima Purnamasari, I Nyoman Latra, Purhadi</i>	M – 45
09	<b>Spatial Extreme Value Using Bayesian Hierarchical Model For Precipitation Return Levels Prediction</b> <i>Indria Tsani Hazhiah, Sutikno, Dedy Dwi Prastyo</i>	M – 51
10	<b>Propensity Score Stratification Analysis using Logistic Regression for Observational Studies in Diabetes Mellitus Cases</b> <i>Ingka Rizkyani Akolo, B.W.Otok, Santi W. Purnami, Rama Hiola</i>	M – 59
11	<b>Performance of W-AMOEBA and W-Contiguity matrices in Spatial Lag Model</b> <i>Jajang and Pratikno, B.</i>	M – 67
12	<b>Parameter Estimation and Hypothesis Testing Geographically Weighted Bivariate Zero-Inflated Poisson</b> <i>Joice Pangulimang, Purhadi, Sutikno</i>	M – 73
13	<b>Univariate and Multivariate Time Series Models to Forecast Train Passengers in Indonesia</b> <i>Lusi Indah Safitri, Suhartono, and Dedy Dwi Prastyo</i>	M – 79
14	<b>Derivation of One Dimensional Continuity Equation for Fluid Flows in Deformable Pipelines</b> <i>Nur Endah Ardiyanti, Nikenasih Binatari</i>	M – 87
15	<b>Nonlinearity Test on Time Series Data Case Study: The Number of Foreign Tourists</b> <i>Rahma Dwi Khoirunnisa, Wahyu Wibowo, Agus Suharsono</i>	M – 93
16	<b>Analyzing Of Bank Performance Level Using Rgec And Mamdani Fuzzy System Implemented With Graphical User Interface</b> <i>Rani Mita Sari, Agus Maman Abadi</i>	M – 99

17	<b>Analysis Propensity Score with Structural Equation Model Partial Least Square</b> <i>Setia Ningsih, B. W. Otok, Agus Suharsono, Reni Hiola</i>	M – 109
18	<b>Regression Spline Truncated Curve in Nonparametric Regression</b> <i>Syisliawati, Wahyu Wibowo, I Nyoman Budiantara</i>	M – 115
19	<b>Construction of Fuzzy System of Zero-Order Takagi-Sugeno-Kang Using Singular Value Decomposition Method and Its Application for Diagnosing Cervical Cancer</b> <i>Triyanti, Agus Maman Abadi</i>	M – 123
20	<b>Construction of Fuzzy Rules of Zero Order Takagi-Sugeno-Kang Fuzzy System Using Generalized Matrix Inverse Method and Its Application for Diagnosing Breast Cancer</b> <i>Weni Safitri, Agus Maman Abadi</i>	M – 129
21	<b>Global Stability of SACR Epidemic Model for Hepatitis C on Injecting Drug Users</b> <i>Dwi Lestari, Lidyana Candrawati</i>	M – 137
22	<b>The Greatest Solution of Inequality <math>A \circ X \leq B \circ X</math> By Using A Matrix Residuation Over An Idempotent Semiring</b> <i>Eka Susilowati</i>	M – 147
23	<b>Implementation Coloring Graph and Determination Waiting Time Using Welch-Powell Algorithm in Traffic Light Matraman Mathematics</b> <i>Hengki Harianto, Mulyono</i>	M – 155
24	<b>The Normality of Subgroups of <math>n \times n</math> Matrices Over Integers Modulo Prime</b> <i>Ibnu Hadi</i>	M – 161
25	<b>Adjacency Metric Dimension of Graphs with Pendant Points</b> <i>Rinurwati, Herry Suprajitno, Slamir</i>	M – 165
26	<b>Parameter Estimation Smith Model of Max-Stable Process Spatial Extreme Value</b> <i>Siti Azizah, Sutikno, Purhadi</i>	M – 171
27	<b>Rainfall Forecasting Using Bayesian Nonparametric Regression</b> <i>Suwardi Annas, Rizwan Arisandi</i>	M – 183
28	<b>Least Squares Estimator for <math>\beta</math> in Multiple Regression Estimation</b> <i>Tubagus Pamungkas</i>	M – 189
29	<b>Computing Generator Of Second Homotopy Module</b>	M – 193

**$\langle a, b; a^p, b^q, aba^{-1}b^{-1} \rangle$  And  $\langle t; t^{pq} \rangle$  Using Tietze Transformation Methods**  
*Yanita*

## MATHEMATICS EDUCATION

- |    |   |         |
|----|---|---------|
| 01 | <b>Literatur Study: The Relationship Of Mathematics Problem Solving And Students' Higher Order Thinking Skills</b><br><i>Adri Nofrianto, Mira Amelia Amri, Elfa Rafulta</i>                           | ME – 1  |
| 02 | <b>A Study Of Reflective-Preservice Mathematics Teacher's Reflective Thinking In Solving Geometrical Problem</b><br><i>Agustan S., Dwi Juniati, Tatag Yuli Eko Siswono</i>                            | ME – 7  |
| 03 | <b>A Study Of Late Formal-Junior School Student's Geometric Thought In Understanding The Relationship Between Quadrilateral</b><br><i>Agustan S.</i>  | ME – 15 |
| 04 | <b>Adaptive Reasoning And Strategic Competence In Solving Mathematical Problem: A Case Study Of Male-Field Independent (Fi) Student</b><br><i>Andi Syukriani, Dwi Juniati, Tatag Yuli Eko Siswono</i> | ME – 21 |
| 05 | <b>The Characteristics Of Students' Refractive Thinkingabout Data</b><br><i>Anton Prayitno</i>  | ME – 29 |
| 06 | <b>Effectiveness Of Tps And Sgd With Scientific Approach In Terms Of Problem-Solving And Self-Confidence</b><br><i>Anwar Rifa'i, Himmawati Puji Lestari</i>   | ME – 39 |
| 07 | <b>The Characteristics Of Teachers' Contingent Dominant Scaffolding In Teaching And Learning Mathematics</b><br><i>Anwar, Ipung Yuwono, Edy Bambang Irawan, Abdur Rahman Asari</i>                    | ME – 47 |
| 08 | <b>Effectiveness Problem Based Learning And Scientific Approach To Improve Higher Order Thinking Skills</b><br><i>Arini Ulfah Hidayati, Heri Retnawati</i>  | ME – 55 |
| 09 | <b>The Excellence Of Realistic Mathematic Education Based On Gardner's Multiple Intelligences Theory Through Mathematical Connection Ability</b><br><i>Aris Kartikasari, Rita Suryani</i>             | ME – 61 |
| 10 | <b>Characterization Of Mathematical Connections In Calculus</b><br><i>Arjudin, Akbar Sutawidjaja, Edy Bambang Irawan, Cholis Sa'dijah</i>   | ME – 67 |
| 11 | <b>The Effect Of Problem Based Learning To Mathematical Reasoning Abilities Of High School Students, Topic: Series And Sequence</b><br><i>Azmi Yanianti, Fitriani</i>                                 | ME – 73 |

- |    |  |          |
|----|--|----------|
| 12 | <b>Developing Reasoning Ability And Curiosity Of Students Toward Mathematics Through Problem Based-Learning</b><br><i>Bukhori, Heri Retnawati</i>                                | ME – 79  |
| 13 | <b>The Development Of Module Of Learning Quadrilateral Based On Van Hiele Theories</b><br><i>Deshinta P.A.D. Argaswari, Budi Usodo, Ikrar Pramudya</i>                           | ME – 85  |
| 14 | <b>The Role Of Productive Struggle To Enhance Learning Mathematics With Understanding</b><br><i>Dian Permatasari</i>   | ME – 95  |
| 15 | <b>Didactical Design Research of Mathematical Communication about Concept of Cuboid Volume in Elementary School</b><br><i>Hj. Epon Nur'aeni, Muhammad Rijal Wahid Muharram</i>   | ME - 101 |
| 16 | <b>The Characterization Of Mathematics Students' Metacognition Process In Solving Mathematical Problems</b><br><i>Dwi Purnomo, Toto Nusantara, Subanji, Swasono Rahardjo</i>     | ME – 105 |
| 17 | <b>Students' Anxiety Facing Computer Based Test (CBT) System Of National Examination</b><br><i>Eny Sulistyaningsih</i>   | ME – 113 |
| 18 | <b>Increasing Higher Order Thinking Skill To Build Student's Character By Using Mathematical Reasoning</b><br><i>Evvy Lusyana, Magdalena Wangge</i>                              | ME – 119 |
| 19 | <b>Fostering Student's Higher-Order Thinking Skill Through Problem-Based Learning In Calculus</b><br><i>Hasan Djidu, Jailani</i>   | ME – 127 |
| 20 | <b>The Student' Models For The Meaning And Procedure Of Multiply Two Fractions</b><br><i>Hongki Julie</i>  | ME – 131 |
| 21 | <b>Hypnoteaching Method To Foster Self - Belief Of Primary School Students In Learning Math</b><br><i>Imaludin Agus, Ayu Arfiana</i>   | ME – 139 |
| 22 | <b>Analyze Of The Creative Thinking Level Of Students Junior High School Viewed From Mathematics Anxiety</b><br><i>Isnaeni Umi Machromah, Budi Usodo</i>                         | ME – 145 |
| 23 | <b>The Technique and Validation of Composing the Attitude Assessment Instrument for Junior High School Mathematics Learning Based on Curriculum 2013</b><br><i>Kana Hidayati</i> | ME – 151 |

24	<b>The Role of Metacognitive in Problem Solving: A Case in Logarithm</b> <i>Masduki, Heri Kusuma</i>	ME – 157
25	<b>Developing Mathematics Instructional Package with POGIL that is Oriented to The Competences in Curriculum 2013</b> <i>Mega Eriska Rosaria Purnomo, Agus Maman Abadi</i>	ME – 163
26	<b>The Development of Interactive Learning Media to Explore The Students' Mathematical Creative Thinking Ability</b> <i>Nani Ratnaningsih</i>	ME – 173
27	<b>Guided Discovery: A Method to Minimize The Tendency of Students' Rote-Learning Behavior in Studying Trigonometry</b> <i>Naufal Ishartono</i>	ME – 181
28	<b>The Effect Of CTL Approach With Talking-Chips Setting On Mathematical Communication Of Junior High School's Students</b> <i>Nina Agustyaningrum</i>	ME – 191
29	<b>Developing A Mathematics Instructional Model Based On Child Friendly, Innovative , Creative and Realistics (CFICR) At Junior High School</b> <i>Nining Setyaningsih, Sri Rejeki</i>	ME – 197
30	<b>Role Of Scaffolding Toward Enhancing Understanding Of Low-Achieving Students (LAS) In Mathematics Learning</b> <i>Pika Merliza, Uke Ralmugiz, Arsyil Waritsman</i>	ME – 203
31	<b>Developing Students' Mathematical Reasoning Through Learning Mathematics with Analogical Reasoning</b> <i>Retno Kusuma Ningrum, Nurul Husnah Mustikasari</i>	ME – 209
32	<b>Undergraduate Student's High Order Mathematical Thinking Abilities Through Lesson Study Activities</b> <i>Risnanosanti</i>	ME – 217
33	<b>Analysis of Statistical Reasoning Process of Senior High School Students on the Size of Central Tendency (The Case Study For Student's Low Math Ability)</b> <i>Rosidah</i>	ME – 225
34	<b>Facilitating Students From Inadequacy Concept in Constructing Proof to Formal Proof</b> <i>Syamsuri, Purwanto, Subanji, Santi Irawaty</i>	ME – 233
35	<b>Adaptive Reasoning Junior High School Students In Mathematics Problem Solving</b> <i>Teguh Wibowo</i>	ME – 239

- |    |  |          |
|----|--|----------|
| 36 | <b>Active Learning Optimization to Improve Students Critical and Creative Mathematical Thinking</b><br><i>Tri Rahmah Silviani, Atik Lutfi Ulin Ni'mah</i>                        | ME – 245 |
| 37 | <b>Metacognition Students In Problem Solving</b><br><i>Ummu Sholihah</i>   | ME – 253 |
| 38 | <b>Developing Mathematics Learning Material Based On CTL For Senior High School, Topic: Series and Sequence</b><br><i>Venti Indiani, Dyah Purboningsih</i>                       | ME – 257 |
| 39 | <b>Teachers' Perception Towards ICT in Mathematics Class: A case study in Yogyakarta Secondary Schools</b><br><i>Wahyu Setyaningrum</i>  | ME – 263 |
| 40 | <b>Ethnomathematics in Marriage Tradition in Adonara Island-East Flores</b><br><i>Wara Sabon Dominikus, Toto Nusantara</i>   | ME – 269 |
| 41 | <b>Abstraction Measurement of Students in Constructing Proof Algebra Problems</b><br><i>Warli, Edy Nurfalah</i>  | ME – 275 |
| 42 | <b>An Analysis of Student's Error in Solving PISA Problems</b><br><i>Yurizka Melia Sari, Erik Valentino</i>  | ME – 285 |
| 43 | <b>Integrating Technology in Inquiry Based Learning</b><br><i>Aprilia Dwi Handayani</i>  | ME – 293 |
| 44 | <b>Characterization of Spontaneous Examples Based on Teacher and Student Thinking Interaction in Mathematics Learning</b><br><i>Baharullah, Purwanto, Subanji, Edy Bambang</i>   | ME – 299 |
| 45 | <b>An Analysis of Problems on Eight Grade of Mathematics Textbook Based on PISA's Framework</b><br><i>Budi Murtiyasa, Sri Rejeki, Sarlita Murdaningsih</i>                       | ME – 305 |
| 46 | <b>The Use of Problem Based Learning to Improve Higher Order Thinking Skills in Junior Secondary School</b><br><i>Dita Puspitawedana, Jailani</i>                                | ME – 309 |
| 47 | <b>Integrating Maratib Qira'ah Al-Qur'an and Marzano's Taxonomy to Provides Learning Objectives in Mathematics</b><br><i>Kusaeri and Dwi Prasetyo Pribadi</i>                    | ME – 315 |
| 48 | <b>Probabilistic Thinking of Elementary School Students in Solving Contextual and Non Contextual Probability Tasks</b><br><i>Dwi Ivayana Sari, I Ketut Budayasa, Dwi Juniati</i> | ME – 323 |



49	<b>Students' competence Development on Learning Fractal Geometry by Experiments Using ICT Tool</b> <i>Dwi Juniati, I Ketut Budayasa</i>	ME – 331
50	<b>Creative Problem Solving to Improve Students' Higher Order Thinking Skills in Mathematics Instructions</b> <i>Ezi Apino, Heri Retnawati</i>	ME – 339
51	<b>Effect Size Of Pakem Model Implementation In Mathematic Learning On Improving Student's Problem-Solving Mastery On Function Material At Junior High School</b> <i>Fauzan Jafri</i>	ME – 347
52	<b>Improving Students' Logical Thinking Mathematic Skill Through Learning Cycle 5E and Discovery Learning</b> <i>Gida Kadarisma</i>	ME – 351
53	<b>Multiple Mathematical Representation Profile of Grade VIII Based on Multiple Intelligences</b> <i>Hestu Wilujeng, Yenni</i>	ME – 357
54	<b>Critical Thinking Skills Development Through Interactive Mathematical Learning Media</b> <i>Hetty Patmawati</i>	ME – 363
55	<b>Development of Measurement Model Construct Student Persistence of the Open Learning University (UT)</b> <i>Isfarudi</i>	ME – 367
56	<b>Mathematical Algorithm on Conventional Computerized Adaptive Testing</b> <i>Iwan Suhardi</i>	ME – 377
57	<b>The Development of Students Worksheet Using GeoGebra Assisted Problem-Based Learning and Its Effect on Ability of Mathematical Discovery of Junior High Students</b> <i>Joko Suratno</i>	ME – 385
58	<b>Building Student's Honesty Through Contextual Mathematics Learning</b> <i>Lokana Firda Amrina, Novalinda Puspita Ayu, Nurfarahin Fani</i>	ME – 395
59	<b>Teacher's Pedagogical Content Knowledge Concerned To Students Knowledge On Quadratic Function</b> <i>Ma'rufi</i>	ME – 399
60	<b>Actualization Pedagogical Content Knowledge (PCK) of Novice Teachers in Learning Practice at Systems of Linear Equations of Two Variables (SPLDV)</b>	ME – 407

*Maryono, Akbar Sutawidjaja, Subanji, Santi Irawati*

- |    |   |          |
|----|---|----------|
| 61 | <b>Effectiveness of Cooperative Learning Approach (Snowball Throwing) in Logics Instruction at AMIKOM Mataram</b><br><i>Muhamad Galang Isnawan, Teguh Rizali Zahroni</i>                                  | ME – 415 |
| 62 | <b>Prospective Teachers' Structure Patterns of Awareness and Regulated Thinking During Solving Problems In Algebra</b><br><i>Muhammad Baidawi, Akbar Sutawidjaja, Edy Bambang Irawan, I Made Sulandra</i> | ME – 419 |
| 63 | <b>Authentic Assessment On Mathematics Education Research Methodology Course Based Group Discussion</b><br><i>Muhammad Ilyas</i>  | ME – 427 |
| 64 | <b>Pre-service Teacher Interpretations of Students' Mathematical Understanding</b><br><i>Mujiyem Sapti, Purwanto, Sri Mulyati, Edy Bambang Irawan</i>   | ME – 435 |
| 65 | <b>Development Interactive Learning Media to Excavate Ability Mathematical Creative Thinking Students</b><br><i>Nani Ratnaningsih</i>   | ME – 443 |
| 66 | <b>Improve Analytical Thinking Skill and Mathematical Representation of The Students Through Math Problem Solving</b><br><i>Novika Sukmaningthias, Aida Rukmana Hadi</i>                                  | ME - 449 |
| 67 | <b>Development of SMP Student Mathematical Inductive Reasoning and Beliefs With Guided Inquiry Learning</b><br><i>Nurmuludin</i>  | ME - 455 |
| 68 | <b>Van Hiele Theory to Improve Higher Order Thinking Skills in Geometry</b><br><i>Oktaviana Mutia Dewi , Heri Retnawati</i>   | ME – 463 |
| 69 | <b>The Implementation Of Contextual Teaching And Learning In Differential Equations</b><br><i>Rita Pramujiyanti Khotimah, Masduki</i>   | ME – 467 |
| 70 | <b>Analogy Reasoning Ability Students' In Solving Algebra Problem Based On Sternberg Theory</b><br><i>Siti Lailiyah</i>   | ME – 475 |
| 71 | <b>Accomplishing Mathematics Problems Using <i>Outside The Box</i> Thinking Phase</b><br><i>Sri Hariyani, Ipung Yuwono, Cholis Sa'dijah, Swasono</i>  | ME – 481 |
| 72 | <b>Student's Self-Efficacy In Mathematics</b><br><i>Sri Hastuti Noer</i>  | ME – 487 |

- |    |  |          |
|----|--|----------|
| 73 | <b>Autistic Gesture in Recognizing Geometrical Shape</b><br><i>Sriyanti Mustafa</i>  | ME – 493 |
| 74 | <b>The Effectiveness Of Teaching Materials Integrated Local Culture Aspect Of Massenrempulu In Mathematic Learning</b><br><i>Sulvianti</i>   | ME – 499 |
| 75 | <b>Effectiveness of Cooperative Learning Approach (Snowball Throwing) in Logics Instruction at AMIKOM Mataram</b><br><i>Muhamad Galang Isnawan, Teguh Rizali Zahroni</i>                     | ME – 509 |
| 76 | <b>“ELIP – MARC” Activities Via TPS of Cooperative Learning to Improve Student’s Mathematical Reasoning</b><br><i>Wisulah</i>  | ME – 513 |
| 77 | <b>Improving students’ Mathematical Literacy Skills Through Mathematical Process Skills Approach</b><br><i>Indrie Noor Aini</i>  | ME – 523 |
| 78 | <b>Measuring Religiosity and Other Affective Domain with Likert and Inventory Scales in Teaching and Learning Mathematics</b><br><i>Dewi Mardhiyana, Jailani</i>                             | ME – 531 |
| 79 | <b>Analysis of Students’ Ability on Mathematical Problem Solving in the Course of Mathematical Physics Through Inquiry Approach</b><br><i>Syarifah Fadillah, Wahyudi, Dwi. Fajar Saputri</i> | ME - 541 |

## PHYSICS

- |    |  |      |
|----|--|------|
| 01 | <b>Numerical Study of Material Carrier Car on a Belt Conveyor Using the Totally Asymmetric Simple Exclusion Processes with Parallel Updating and Periodic Boundary Condition</b><br><i>Anggraeni Kumala Dewi, Steffannie Natalia Asturida Hariyono, Wipsar Sunu Brams Dwandaru</i> | P-1  |
| 02 | <b>Peak Ground Acceleration For Kulon Progo Regency Based On Microtremor Measurements</b><br><i>Bambang Ruwanto, Lian Karlina Saputri, Denny Darmawan, Yosaphat Sumardi, Nugroho Budi Wibowo</i>   | P-9  |
| 03 | <b>The Effect of Alum Layer in The Construction Of Biosand Filter As A Method To Manage The Laundry Wastewater</b><br><i>Dyah Kurniawati Agustika, Muhammad Anshori</i>  | P-11 |
| 04 | <b>The Accuracy Of Ore Reserves Estimation</b><br><i>Eddy Winarno, Gunawan Nusanto, Peter Eka Rosadi</i>   | P-17 |

05	<b>Heat Transfer Benchmark Problems Verification of Finite Volume Particle (FVP) Method-based Code</b> <i>Rida SN Mahmudah, Koji Morita</i>	P-25
07	<b>Radioactive Elements in Consumer Products</b> <i>Rindi Ganesa Hatika</i>	P-33
06	<b>Relativistic Deuteron In One-Pion Exchange</b> <i>R. Yosi Aprian Sari, Denny Darmawan</i>	P-39

## PHYSICS EDUCATION

01	<b>Quantitative Comparison Of The Effect Factors In Electromagnetic Induction Using Audacity Freeware</b> <i>Ahmad Tarmimi Ismail, Rosly Jaafar, Nik Syaharudin Nik Daud, Shahrul Kadri Ayop</i>	PE-1
02	<b>Learning Difficulties Analysis of the Students of Pendidikan Fisika Universitas Ahmad Dahlan to the subject Evaluasi Proses dan Hasil Belajar Fisika</b> <i>Dian Artha Kusumaningtyas</i>	PE-7
03	<b>Development Of Indonesian Qualification Framework (IQF) Level 6 Of Physics Education</b> <i>Didik Setyawarno, Zuhdan Kun Prasetyo</i>	PE-11
04	<b>The Application Of GPCM On MMC Test As A Fair Alternative Assessment Model In Physics Learning</b> <i>Edi Istiyono</i>	PE-25
05	<b>Critical Thinking Skills Profile of High School Students In Learning Science-Physics</b> <i>Khaeruddin, Mohammad Nur, Wasis</i>	PE-31
06	<b>Online Peer-Assessment in Teaching Physics in English Class for Improving Pre-Service Physics Teachers Learning</b> <i>Khusaini</i>	PE-37
07	<b>The Effect of Guide Note Taking Learning Strategy Toward The Students' Critical Thinking Skill</b> <i>Misbah, Syubhan An'nur, Yasmine Khairunnisa</i>	PE-41
08	<b>Video-based Instruction for Video Analysing Process of Physics Experiment</b> <i>Nik Syaharudin Nik Daud, Rosly Jaafar, Nor Azimah Abdul Mukti and Ahmad Tarmimi Ismail</i>	PE--45

09	<b>Development Of Website “Measuring Instrument” Through Blended Learning</b> <i>Setuju</i>	PE-51
10	<b>Guided Inquiry Learning Using Virtual Laboratory To The Mastery Of The Concepts Of Physics</b> <i>Siti Juwariyah, Soepriyono Koes, Eny Latifah</i>	PE-59
11	<b>The Attainment Of Learning Outcomes Of Indonesian Qualification Framework Level 6 Among Physics Teachers</b> <i>Sarah, Siti</i>	PE-65
12	<b>Validity Of Collaborative Creativity Model</b> <i>Sri Astutik, Mohamad Nur, Endang Susantini</i>	PE-73
13	<b>Validity of Physics Module Using Cooperative Learning Model With Peer Assessment</b> <i>Sri Hartini, Mustika Wati, Sayidah Mahtari, Hayatul Mu’awwanah</i>	PE-79
14	<b>Syar Fisika Melalui Sosial Media: An Effort to Change the Habit of The College Students in The Use of Social Media</b> <i>Toni Kus Indratno, Ginanjar A. Muhammad, Yulien Akhmad Zein</i>	PE-83

## CHEMISTRY

01	<b>Synthesis of in-house PEDOT/PSS dispersion and its performance on OPV device</b> <i>Anang WM Diah</i>	C-1
02	<b>Chitosan-Key Lime Film for Food Preservation</b> <i>Azlan Kamari, Al Luqman Abdul Halim, Helwa Fathi Hadzri, Nor Haida Mohamad Yahaya</i>	C-9
03	<b>Indonesian Natural Zeolites as potential Adsorbent in Waste Cooking Oil Regeneration</b> <i>Dewi Yuanita Lestari, Dyah Purwaningsih, Antuni Wiyarsi</i>	C-17
04	<b>QSAR Study Of Antimalaria Of Xanthone Derivatives Using Multiple Linear Regression Methods</b> <i>Dhina Fitriastuti, Jumina, Iqmal Tahir and Priatmoko</i>	C-23
05	<b>Compound Analysis Of Kembang Bulan (<i>Tithoniadiversifolia</i>) Leaves</b> <i>Amanatie</i>	C-31
06	<b>Development of LiMn<sub>2</sub>O<sub>4</sub> Cathode Materials for Lithium Battery</b> <i>Dyah Purwaningsih</i>	C-41
07	<b>Modification Of Lac Insect Secretion By Using Adipic Acid As</b>	C-49

**Matrix In Preparation Of Biocomposite**

*Eli Rohaeti, Mujiyono, Rochmadi*

- |    |   |       |
|----|---|-------|
| 08 | <b>Preparation And Characterization Of Cobalt Oxide Supported Tin Oxide (CoOx@SnO<sub>2</sub>) As Photocatalysts</b><br><i>Etifebriani, A.K. Prodjosantoso, Cahyorini Kusumawardani</i>   | C-59  |
| 09 | <b>Effect Of Existence Zn<sup>2+</sup> And Cu<sup>2+</sup> Ions On Extraction Efficiency Of Gold(III) Using Polyethylene Glycol</b><br><i>Gatut Ari Wardani, Sri Juara Santosa, Indriana Kartini</i>  | C-65  |
| 10 | <b>Comparative Study On The Impact Of Synthesis Route To The Photocatalytic Activity Of ZnO-SiO<sub>2</sub> From Rice Husk Ash</b><br><i>Is Fatimah</i>   | C-69  |
| 11 | <b>An Investigation of Insect Ovipositing Repellent Activity of Andrographis paniculata Ness Leaf Extracts to Batrocera carambolae</b><br><i>Nurchahyo Iman Prakoso, Mila Tria Nita, and Suputa</i>   | C-75  |
| 12 | <b>Isolation of Prenylated Flavone from the Bark of <i>Artocarpus Elasticus</i> Alor Island – East Nusa Tenggara</b><br><i>Rosalina Y. Kurang, Taslim Ersam</i>   | C-79  |
| 13 | <b>Removal Characteristics of Silver with Eelectokinetic by Adsorption on Soil Mineral from Kotagede Yogyakarta</b><br><i>Rudy Syah Putra, Sigit Budiarjo, Nefri Yandi</i>  | C-83  |
| 14 | <b>Synthesis 1-Propanol from Propanoic Acid</b><br><i>Salmahaminati, and Jumina</i>   | C-89  |
| 15 | <b>Paper Indicator Of Wora-Wari Flowers (<i>Hibiscus rosa-sinensis</i> L.)</b><br><i>Siti Nuryanti</i>  | C-95  |
| 16 | <b>Development Of Potential Kunci Pepet (<i>Kaempferia Rotunda</i>) Rhizoma Plant As Antioxidant</b><br><i>Sri Atun and Arista Sundari</i>  | C-99  |
| 17 | <b>The Development of Cinnamalacetone Synthesis Methode Based on Green Chemistry Approach</b><br><i>Sri Handayani</i>   | C-105 |
| 18 | <b>Enhancement of Wastewater Treatment from Chemical Laboratory Using Subsurface Bubble of Air Generator</b><br><i>Rudy Syah Putra, Viola Bestari Ayu Sabrina Putri, Apri Rahmani Miftahul Hidayah, Dian Nurmala Sari, Andhika Ghia Prayojana, Agung Prayudia Maulana</i> | C-111 |
| 19 | <b>Phytochemical and Antibacterial Activity Test Of Secondary</b>   | C-115 |

**Metabolite Compound In Rhizophora mucronata Methanol  
Leaves Extracts**

*Ernawati, Ita Hasmila*

- |    |  |       |
|----|--|-------|
| 20 | <b>Review of the Molecularly Imprinted Hydrogel<br/>In Chemical Analysis</b><br><i>Annisa Fillaeli</i> | C-121 |
|----|--|-------|

**CHEMISTRY EDUCATION**

- |    |  |       |
|----|--|-------|
| 01 | <b>Increasing Effectiveness Of Number Head Together (NHT) Model<br/>Through Integration Of Multiple Intelligences Theory In Chemistry<br/>Lesson</b><br><i>Atiek Winarti</i>                   | CE-1  |
| 02 | <b>Construction of Chemistry Teaching Material Using Organic-LED<br/>(OLED) Context for High School Students</b><br><i>Indah Rizki Anugrah</i>   | CE-9  |
| 03 | <b>Chemistry Teachers' Ability in Measuring Analytical Thinking and<br/>Science Process Skills</b><br><i>Irwanto, Eli Rohaeti</i>  | CE-17 |
| 04 | <b>The Improvement Of Students' Achievement And Social Maturity<br/>On Chemistry Learning Through The Assistance Of Local Wisdom<br/>Videos</b><br><i>Jaslin Ikhsan, Sulistiana Febriawati</i> | CE-25 |
| 05 | <b>Eplovement Of Interactive Student Worksheet Of Chemistry<br/>Learning In Senior High School (SMA)</b><br><i>Muharram, Adnan, Muhammad Anwar</i>   | CE-31 |
| 06 | <b>The Development Of Contextual Collaborative Learning Model For<br/>Chemical Bonding Course</b><br><i>Gani Purwiandono, Is Fatimah, Salmahaminati, Mai Anugrahwati</i>                       | CE-43 |

**BIOLOGY**

- |    |   |      |
|----|---|------|
| 01 | <b>Microbiological Air Quality of Offices and Lecture Rooms in Yala<br/>Rajabhat University</b><br><i>Abdullah Dolah Dalee, Nurainee Hayeeyusoh, Khosiya Sali, Zubaidah<br/>Hajiwangoh, Phurqanni Salaeh &amp; Sukanya Madkep</i> | B-1  |
| 02 | <b>Recruitment And Ability of Seed and Propagule to Grow in<br/>Mangrove Forest Segara Anakan Cilacap</b><br><i>A. Tri Priantoro , P. Sunu Hardiyanta, SJ</i>   | B-9  |
| 03 | <b>Effects Of Peaberry Coffee On The Sexual Behavior and The Blood</b>  | B-21 |

**Testosterone Levels Of The Male Mouse (*Mus musculus*)**

*Bevo Wahono*

- |    |   |      |
|----|---|------|
| 04 | <b>Primer Designing For Molecular Detection of <i>Salmonella</i> Spp Based on <i>Parc</i> Gene</b><br><i>Charis Amarantini, Dhira Satwika</i>   | B-27 |
| 05 | <b>Seed's Viability of Two Types of Dates (<i>Phoenix dactylifera</i> L.) from Fruit in Indonesian Market</b><br><i>Ekosari Roektingroem and Purwanti Widhy Hastuti</i>                               | B-31 |
| 06 | <b>Antimicrobial Activity and Stability of Suji Leaves (<i>Dracaena angustifolia</i> (Medik.) Roxb.) Extract</b><br><i>Eveline, Jessica, and Tagor Marsillam Siregar</i>                              | B-39 |
| 07 | <b>Anticancer Property of Protein Isolated from Thermophilic Bacteria Against Breast T47D Cancer Cell Lines</b><br><i>Evy Yulianti, Anna Rakhmawati, Kartika Ratna Pertiwi</i>                        | B-45 |
| 08 | <b>Organoleptic Test Of Ultra High Temperature (UHT) Milk Yoghurt With The Addition Of Katuk Leaves Extract (<i>Sauropus Androgynus</i>)</b><br><i>Gloria Jessica Santoso, Antonius Tri Priantoro</i> | B-51 |
| 09 | <b>The Effectiveness of <i>Aloe Vera</i> Extracts Against Blood Glucose Levels and Repair The Proportion Pancreatic B Cells of The Hyperglycemic Rats</b><br><i>Irdalisa</i>                          | B-57 |
| 10 | <b>The Different Weight of Rice IR64 As Growth Media Toward Pigments Level Generated by <i>Monascus purpureus</i></b><br><i>Ni Putu Ristiati, Gusti Ayu Made Juniasmita Parsandi</i>                  | B-65 |
| 11 | <b>Diversity and Adaptability of Fiddler Crabs at Different Habitat in Pulau Bai, Bengkulu</b><br><i>Rusdi Hasan</i>  | B-73 |
| 12 | <b>Non Parametric Analysis to Tackle Species Richness</b><br><i>Suhardi Djojoatmodjo</i>  | B-79 |
| 13 | <b>The Biodiversity Of Homegarden As A Family Survival And A Basis Of Tourism Development</b><br><i>Suhartini</i>   | B-89 |

**BIOLOGY EDUCATION**

- |    |  |      |
|----|--|------|
| 01 | <b>Application Of Problem Based Learning And Inquiri To Creative</b> | BE-1 |
|----|--|------|



### **Thinking And Mastery Of Concepts**

*Bagus Endri Yanto*

- |    |   |       |
|----|---|-------|
| 02 | <b>Critical Thinking Ability And Correlation With Student Achievement Index Cumulative</b><br><i>Dede Nuraida</i>   | BE-7  |
| 03 | <b>Analysis of Learning Outcomes of Biology Based Reflective and Impulsive Cognitive Styles</b><br><i>Imas Cintamulya</i>   | BE-13 |
| 04 | <b>The Effect of Service Learning in Biology Class: Philosophy Foundation, Principles, Benefits, and Implementation</b><br><i>Luisa Diana Handoyo</i>   | BE-19 |
| 05 | <b>Implementation of Performance Assessment to Increase Biology Learning Achievement by Using Inquiry Model-Based Lesson Study</b><br><i>Murni Sapta Sari</i>   | BE-29 |
| 06 | <b>The Isolation Of Leukocytes In The Blood Of Cattle As Learning Media Cytology-Histology</b><br><i>Ni Luh Putu Manik Widiyanti</i>  | BE-35 |
| 07 | <b>The Effect of Problem- Based Learning on Critical Thinking and Student Achievement</b><br><i>Rizqa Devi Anazifa</i>  | BE-42 |
| 08 | <b>Relationship Between Junior High School Science Teachers' Understanding Of Inquiry Learning Based On Their Teaching Experience And School Type</b><br><i>Suciati, Chrisnia Octovi, Dyah Pitaloka</i> | BE-49 |

### **SCIENCE EDUCATION**

- |    |   |       |
|----|---|-------|
| 01 | <b>Developing Integrated Science Module of Calor Theme in a Guided Inquiry Based Learning</b><br><i>Ariati Dina Puspitasari</i>   | SE-1  |
| 02 | <b>Improving Students' Entrepreneurial Attitude Through Local Potential Pottery And Furniture Of Jepara</b><br><i>Aries Anisa, I Gusti Putu Suryadarma, Insih Wilujeng, Zuhdan Kun Prasetyo</i> | SE-7  |
| 03 | <b>Practicality of Cognitive Style-Based Learning Strategy for Developing Science Problem Solving Ability of Elementary Students</b><br><i>Arif Sholahuddin, Leny Yuanita, Suparman Kardi</i>   | SE-17 |
| 04 | <b>'New Pedagogies' of Experience Based Learning Form in Science</b>  | SE-25 |

## **Learning**

*Asri Widowati*

- |    |   |       |
|----|---|-------|
| 05 | <b>Collaboration of Traditional Games with Science-Based Inquiry and Scientific Approach</b><br><i>Astuti Wijayanti</i>   | SE-33 |
| 06 | <b>Developing an Authentic Assessment Science Process Skills, Critical Thinking Skills and Problem Solving Skills</b><br><i>Dadan Rosana, Supahar, Deby Kurnia Dewi, Esmiyati, Vidya Putri Sukmasari</i>                                    | SE-37 |
| 07 | <b>Effectiveness Of Scientific Approach Integrating Onion Agriculture Potential Viewed From Secondary School Students' Environmental Care Attitude</b><br><i>Dani Setiawan, Insih Wilujeng</i>  | SE-43 |
| 08 | <b>Activism of The Students in Reflective Thinking Learning Method with Brainstorming and Oriented in Question</b><br><i>Fajar Fitri</i>  | SE-49 |
| 09 | <b>Development The Subject Specific Pedagogy (SSP) of Natural Science to Optimize Mastery Knowledge, Attitude, and Skills Junior High School Students in Yogyakarta</b><br><i>Insih Wilujeng, Zuhdan Kun P, Djukri</i>                      | SE-53 |
| 10 | <b>Developing Computer-Based Instructional Media on Sound Wave and Hearing Topics to Improve Learning Outcomes in Observing, Questioning, Collecting, Associating or Analyzing, and Communicating Information</b><br><i>Laifa Rahmawati</i> | SE-61 |
| 11 | <b>Effectiveness of Learning with Authentic Task to Improve Science Literacy Skill in Unipdu Jombang</b><br><i>Miftakhul Ilmi S. Putra, Wahono Widodo, Budi Jatmiko</i>   | SE-65 |
| 12 | <b>Inquiry Science Issues to Cultivate the Critical Thinking in Science Learning</b><br><i>Purwanti Widhy H</i>   | SE-75 |
| 13 | <b>The Model of Educational Reconstruction: Integrating Content and Nature of Science in Teaching Materials</b><br><i>Putri Anjarsari</i>   | SE-81 |
| 14 | <b>Pedagogical Content Knowledge Case Studies at Junior High School of First Class Science Teacher, in 2013 Curriculum Implementation</b><br><i>Susilowati, Purwanti Widhy H</i>  | SE-87 |

## Critical Thinking Skills Profile of High School Students In Learning Science-Physics

KHAERUDDIN<sup>1</sup>, MOHAMMAD NUR<sup>2</sup>, WASIS<sup>3</sup>

<sup>1</sup> Physics Education Study Program State University of Makassar

<sup>2,3</sup> PPs Science Education Studies Program, State University of Surabaya

**Abstract**-This study aims to describe Critical Thinking Skills high school students in the city of Makassar. To achieve this goal, the researchers conducted an analysis of student test results of 200 people scattered in six schools in the city of Makassar. The results of the quantitative descriptive analysis of the data found that the average value of students doing the interpretation, analysis, and inference in a row by 1.53, 1.15, and 1.52. This value is still very low when compared with the maximum value that may be obtained by students, that is equal to 10.00. This shows that the critical thinking skills of high school students are still very low. One fact Competency Standards science subjects-Physics is demonstrating the ability to think logically, critically, and creatively with the guidance of teachers and demonstrate the ability to solve simple problems in daily life. In fact, according to Michael Scriven stated that the main task of education is to train students and or students to think critically because of the demands of work in the global economy, the survival of a democratic and personal decisions and decisions in an increasingly complex society needs people who can think well and make judgments good. Therefore, the need for teachers in the learning device scenario such as: driving question or problem, authentic Investigation: Science Processes.

*Keywords: Profiles, Critical Thinking Skills, interpretation, analysis, inference.*

### I. INTRODUCTION

Critical thinking skills are skills that must be nourished for students and university students to be able to compete in the 21st century, but to develop the thinking skills including critical thinking skills lies in the skills of the students (National Education Standards, 2006). According Karamustafaoglu (2011), the development of science process skills enable students to construct and solve problems and think critically. This possibility can occur because the components of critical thinking is largely a component of science process skills such as designing experiments, testing hypotheses, hypothesizing, predicting, inferring, classifying, measuring, observing (Hassard, J., 2005, p.332). Thus, if students' science processes skill developed, critical thinking skill will evolve Too. One of the Competency Standards (SKL) in the science subjects demonstrated the ability to think logically, critically, and creatively with the guidance of teachers and showing the ability to solve simple problems in daily life. This means that after following the science lessons, students are expected to have the ability to think critically. However, the background of this study have stated that one of the indicators of non-optimal ability to think, work and behave and communicate science students is poor science process skills of students. Though science process skills can spur the development of a variety of thinking skills of students. From this brief description indicates that students' critical thinking skills should be developed through learning.

According to Michael Scriven, the main task of education is to train students and university students to think critically because of the demands of work in the global economy, the survival of a democratic and personal decision in the complex society needs people who can think well and make good judgments (Jennifer. H, 1998). Therefore, critical thinking is an essential tool that is taught to students and or students to succeed in a world that is increasingly complex and rapidly changing. Brookfield encourages educators to take a critical reflective stance toward teaching and helping students to face their world or environment with compassion, understanding, and justice. When teachers practice critical thinking, it encourages the creation of a democratic classroom (Ozkahraman Yildirim S & B: 2011). Paul believes that critical thinking is an important basis for education to adapt the demands of the 21st century,

personally and socially. In view of the rapidly changing world and global reality there is a critical need for individuals to develop skills and abilities that enable them to adapt and respond the demands of the 21st century.

Based on Some experts' opinion regarding the concept of critical thinking skills, the author can state that critical thinking skills are thinking skills that involve high-level cognitive processes, namely interpretation, analysis, evaluation, and inference through scientific procedures in order to solve the problem (Dewey, 1991; Kurfiss, 1991; Burden and Byrd, 2007; Beyer, 2008; Screven, Paul and Angelo, 2008; Rudinow and Barry, 2008). From the definition above, the authors make as an indicator of critical thinking skills in this study is the interpretation, analysis, and inference.

## II. RESEARCH METHOD

This study was a descriptive study to reveal the critical thinking skills of high school students. Giving critical thinking skill test to the students of senior high school in Makassar city with the total number of students are 200 persons. Critical Thinking Ability Test (CTAT) of Physics is structured with the following steps: (i) Adapting questions from physics book: Principle and Problems by Zitzewitz, P., W., et. al. The questions which were adapted are the questions that match with the indicators of critical thinking skills, they are; **interpretation, analysis, inference**, (ii) Giving to some colleagues that have background of Bachelor of education, master degree, and doctoral program, for validating readability of physics critical thinking skills question. The technique of data collecting were Critical Thinking Ability Test (CTAT) of physics to measure students' critical thinking skill include high level cognitive processes, namely interpretation, analysis and inference through scientific procedures in order to solve the problem. While the data analysis technique used quantitative descriptive techniques.

## III. RESULTS AND DISCUSSION

### A. Results

This study aims to describe critical thinking skills of students at several high schools in Makassar. The detailed results of critical thinking skills such as Table 1 below.

TABLE 1. CRITICAL THINKING SKILL'S TEST HIGH SCHOOL STUDENTS

School Name	Indicator Critical Thinking Skills		
	<i>Interpretation</i>	<i>Analysis</i>	<i>Inference</i>
<i>SMAN 2 Makassar</i>	<i>1.50</i>	<i>0.08</i>	<i>0.28</i>
<i>SMAN 9 Makassar</i>	<i>0.81</i>	<i>0.14</i>	<i>0.86</i>
<i>SMAN 10 Makassar</i>	<i>1.16</i>	<i>0.76</i>	<i>0.88</i>
<i>SMAN 14 Makassar</i>	<i>0.90</i>	<i>0.71</i>	<i>2.00</i>
<i>SMAN 15 Makassar</i>	<i>1.25</i>	<i>0.47</i>	<i>1.56</i>
<i>SMAN 17 Makassar</i>	<i>3.56</i>	<i>4.75</i>	<i>3.56</i>
<i>Number</i>	<i>9.18</i>	<i>6.92</i>	<i>9.13</i>
<i>The average value/ indicator</i>	<i>1.53</i>	<i>1.15</i>	<i>1.52</i>

Remarks: maximum value = 10

Table 2 illustrates that the average critical thinking skills include **interpretations** of 1.53, the **analysis** of 1.15, and the **inference** of 1.52. These values indicate that critical thinking skills are still low when compared with the maximum possible value is achieved by the students, that is equal to the value of 10.00. These results, also happens to students of higher education, namely students' critical thinking skills are still low. Results of Critical Thinking Ability Test (CTAT) of students in detail can be seen in Table 2 below.

TABLE 2. RESULTS OF STUDENT CRITICAL THINKING TEST

Department & Class	Indicator Critical Thinking Skills		
	Interpretation	Analysis	Inference
<i>Physics Education</i>	<i>1.50</i>	<i>1.91</i>	<i>2.20</i>
<i>Physics Education International Class A</i>	<i>1.51</i>	<i>1.77</i>	<i>2.42</i>
<i>Physics Education International Class B</i>	<i>1.39</i>	<i>0.69</i>	<i>0.74</i>
<i>Number</i>	<i>4.39</i>	<i>4.38</i>	<i>5.36</i>
<i>The average value / indicator</i>	<i>1.46</i>	<i>1.46</i>	<i>1.79</i>

Remarks: maximum value = 10

Table 2 illustrates that the average of students' critical thinking skills include interpretation of 1.46, analysis of 1.46, and the inference of 1.79.

### B. Discussion

The general objective of this study is to describe the critical thinking skills of high school students in Makassar. Descriptive analysis of the data found that the average value of students doing the interpretation, analysis, and inference in a row by 1.53, 1.15, and 1.52 (Table 1). This value is still very low when compared with the maximum value that may be obtained by students, that is equal to 10.00. This means that the critical thinking skills of high school students are still very low.

In the Journal "Higher Education Research & Development" (2011) states that to make students as critical thinkers in the learning takes five terms, namely:

- (i) the student has the skills and abilities such as how to know, how to evaluate or analyze (Siegel, 1988; Facione, 2006; Khaeruddin, 2013);
- (ii) prepare and prepare learning engages students in critical thinking such as reasoning and analysis (Siegel, 1988; Perkins, Jay & Tishman, 1993; Ennis, 1996; Khaeruddin, 2013),
- (iii) Understand the involvement in learning and understanding that thinking the construction and evaluation of critical reasoning, not show the correct answer or just opinion (Perry, 1990; Kuhn, 1999; Khaeruddin, 2013);
- (iv) Work and meet the criteria to take into account the success of critical thinking (Bailin, Et al., 1999);
- (v) The students understand the material (McPeck, 1981).

Based on some opinions in the Journal "Higher Education Research & Development" above, the results of this study show fact that the lack of critical thinking skills of students resulted by the teacher in the learning process, the teacher seldom stimulate the development of science process skills of students and student critics' skills such as: (i) books that are used less stimulating of critical thinking, creative, and innovative, problem-solving; (iii) use worksheets that do not stimulate the development of science process skills; (iv) the learning objectives in a lesson plan does not specifically oriented toward science process skills. The formulation of learning objectives only cognitive-oriented products, but no true purpose which leads to cognitive processes, namely the higher level thinking; (v) test given to students is still largely oriented cognitive products. This is contrary to the opinion of some experts associated with the requirement to make the students as critical thinkers. It is also proved that the learning results of the test device oriented to the development of critical thinking skills. Teachers were confused in teaching using worksheets that can develop students' ability. In fact, they ask for some questions about "what is the manipulated variable, the response variable, the control variable, why there is no procedure works" The results of this trial reinforces that the worksheets used in the learning process has not stimulated the development of science process skills. That is an important aspect in building scientific literacy of students, it didn't works at all, it was not optimal, i.e. the understanding of the terms in the habits and communicate science in science learning. The way students learn and teachers' ability to recognize the students' potential is not maximized.

In fact, the ability of the teachers to recognize students' potential will facilitate preparing, formulating and implementing the curriculum. The curriculum is then used as a tool to assess the level of

achievement of student learning. To support the implementation of the science curriculum is needed, instructional materials that can develop science process skills. Therefore, the existence of teaching materials is crucial in the success of learning according to the learning objectives. Teaching materials can bridge the experience with the knowledge of students, the adequacy concept, depth, as well as its application in the context of students' daily life.

Therefore, science teaching materials should be drawn up which provides opportunities for students to develop:

- (i) The process skills which include the ability to observe, comparing and contrasting, classifying, measuring, communicating, and the skill of higher level, as predicted, apply concepts, and communicate;
- (ii) The ability inquiry;
- (iii) The ability to think;
- (iv) The ability of scientific literacy in order to understand the science terms (Toharudin 2011: 205).

Thus, science teachers should be good at sorting and selecting strategies according to the characteristics of the science subjects. Learning Science-physics must execute oriented science process skills to cultivate the ability to think, work and behave and communicate scientific as one of the important skills that must be possessed by the student. This is because scientific procedures requiring interpretation in order to solve problems, analysis, and inference, whereas the third indicator is the critical thinking skills that involve high-level cognitive processes (Dewey, 1991; Kurfiss, 1991; Burden and Byrd, 2007; Beyer 2008; Screven, Paul and Angelo, 2008; Rudinow and Barry, 2008).

Even the power of learning science in building students' critical thinking skills lies in the ability to process skills (Science Processes Skills) which stimulate the development of a variety of students' thinking skills and it is the demands of the curriculum 2013 According Karamustafaoglu (2011), the development of science process skills enable students construct and finish problems and think critically. This possibility can occur because the components of critical thinking is largely a component of science process skills such as designing experiments, testing hypotheses, hypothesizing, predicting, inferring, classifying, measuring, observing (Hassard, J., 2005, p.332). Thus, if students' science processes skill developed, critical thinking skill will evolve too. The low critical thinking skills of students, it also happens to a university student. This is shown by the average student critical thinking skills include interpretation of 1.46, analysis of 1.46, and the inference of 1.79 (Table 2). The low critical thinking skills of university students is because they are still getting used to the pattern of learning at the high school level, given the critical thinking skills test is given to students of the second semester.

In addition, the university students mostly from districts in South Sulawesi, learning pattern is approximately same to 6 schools in Makassar as the place to study, even if the terms of the school is below the level of the school in Makassar. However, generally, critical thinking skills of university students are higher than the high school students. This allows the case because in a period of 6 months in the program study physical education, students of State University of Makassar have been doing practicum oriented to Science Skill Processes. But the difference between university students' critical thinking skills and students were not significant. This reinforces the statement Nur (1998: 22) who says that to develop aspects of students' cognitive skills, not an easy job, it takes a long time to build and develop process skills. O'flahavan and Stein (Brunning, 1995) argues that the skills should be done over and over again, whereas according to the Burden and Byrd categorize critical thinking as a thinking activity that requires a high level of cognitive skills (Irani, Rudd, Gallo, Rickets, Friedel, & Rhoades, 2007). Therefore giving an opportunity to students and university students to think critically is not enough, without realization. So students and university students should use the opportunity continuously.

#### IV. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research and discussion, it can be concluded that: Critical thinking skills of high school students in Makassar is still very low when compared with the maximum value of 10.00 which may be obtained by students, namely the interpretation of 1.53, analysis of 1.15, and the inference of 1.52. To cultivate students' critical thinking skills, necessary learning process in the classroom such as: driving question or problem, authentic Investigation: Science Processes Skills, collaboration, and discussion.

## REFERENCE

- [1] Bailin, S., Case, R., Coombs, J.R., Daniels, L.B.. Common Misconceptions of Critical Thinking. *Journal of Curriculum Studies* vol 31, no. 3, 269-283, 1999.
- [2] Brookfield, S. D., Tennant, M., Pogson, P. Theory and methods of educating adults. New York: Wiley, 2005.
- [3] Burden, P.,R. & Byrd, D.M. Methods for effective teaching (4th ed). Boston, M.A: Allyn & Bacon, 2007.
- [4] Bruning, Roger H., Schraw, Gregory J., Ronning, Royce R. Cognitive Psychology and Instruction Second Edition. Ohio: Prentice Hall, 1995.
- [5] BSNP, T. *Standar Isi*. Jakarta: Badan Standar Nasional Pendidikan, 2006.
- [6] Depdiknas. *Kurikulum Berbasis Kompetensi Mata Pelajaran Fisika SMA dan MA*. Jakarta: Depdiknas, 2003.
- [7] Ennis.. *Critical Thinking*. New York: Prentice hall, upper saddle river, 1996.
- [8] Facione, P.A. (2006), Critical thinking: What it is and why it counts. [Online] Available: [www.calpress.com/pdf\\_files/what&why.pdf](http://www.calpress.com/pdf_files/what&why.pdf) (May 7, 2011), 1996.
- [9] Hassard, J. The Art Teaching Science. New York: Oxford University Press, 2005.
- [10] Irani, Rudd, Gallo, Rickets, Friedel, & Rhoades. (2007). *Critical Thinking*. Florida: University of Florida, 2007.
- [11] Jennifer H. (1998). Effect of A Model for Critical Thinking on Student Achievement in Primary Source Document Analysis and Interpretation, Argumentative, Reasoning, Critical Thinking Dispositions, and History Content in A Community College History Course. Florida: Disertation, Education University of South Florida, 1998.
- [12] Karamustafaoglu. (2011). Improving the Science Process Skills Ability of Science Student Teachers Using I Diagrams. *Eurasian Journal of Physics and chemistry Education* , 26-36. 2011.
- [13] Khaeruddin. **Analisis Keterampilan Berpikir Kritis Siswa SMA**. Laporan *Preliminary Study*. PPs Unesa Surabaya, 2013.
- [14] Khaeruddin. **Karakteristik Perangkat Pembelajaran Guru SMA di Tinjau dari Perspektif Keterampilan Berpikir Kritis**. Prosiding Universitas Jember, 2013.
- [15] Kincaid, M. *Learning Thinking and Creative*. Scotlandia: Learning and Teaching Scotland, 2004.
- [16] Kuhn, D. A Developmental model of Critical Thinking Educational researcher 28, 16-26, 46, 1999.
- [17] Mc Peck. Taching Critical Thinking: Dialogue and Dialectica: Routledge, 1990.
- [18] Nur, M. (1998). Proses Belajar Mengajar dengan Pendekatan Keterampilan Proses. Surabaya: SIC Surabaya, 1998.
- [19] Ozkahraman S &Yildirim B. An Overview of Critical Thinking in Nursing and Education. *American International Journal of Contemporary Research Vol. 1 No. 2; September 2011*.
- [20] Paul, R. Critical Thinking: What every person needs to survive in rapidly changing world, Binker, A.J. A(ed) Rohnert Park, CA: center for Critical Thinking and moral critique, 1990.
- [21] Perkins, D.N, Jay, E., & Tishman, S. Beyond abilities: A dispositional theory of thinking. *Merril-Palmer Quarterly: Journal of Developmental Psychology* 39 (1): 1-21 1993.
- [22] Rudinow, J & Barry, V.E. Invitation to Critical Thinking. New York: Thomson Higher Education , 2008.
- [23] Siegel, H. Educating reason: Rationality Critical Thinking and education. London: Routledge 1998.
- [24] Toharudin, U., Sri Hendrawati., Rustaman, A. Membangun Literasi Sains Peserta Didik.Bandung: Humaniora, 2011.